Human Factors in Aviation

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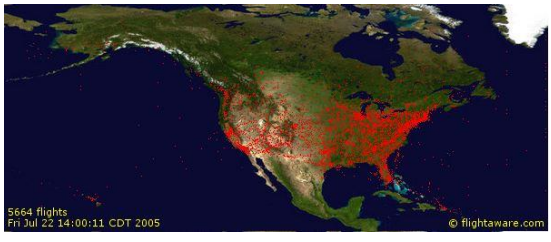
Outline

- Scope of aviation operations
- How human factors affects outcomes
- Contributions of Human Factors to aviation
  - Cockpit technologies
  - Air Traffic Control technologies
- Closing comments

Scope of Aviation Operations

- At any given moment, on a typical day, over 5,000 aircraft are flying in US airspace
- Over 70,000 total flights each day (NATCA, 2012)

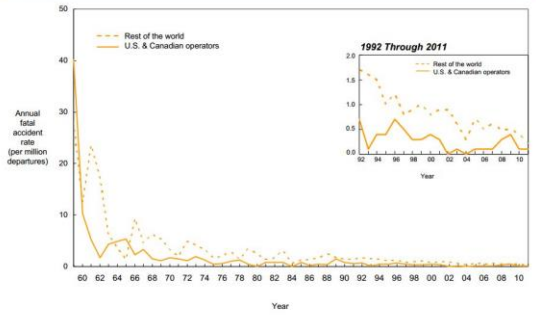


Scope of Aviation Operations

- Human operators flying the aircraft and directing their progress through the National Airspace System
  - Promptly
  - Efficiently
  - SAFELY
- Maintain fatal accident rate (better than) 10^{-9} per flight hour

U.S. and Canadian Operators Accident Rates by Year

Fatal Accidents – Worldwide Commercial Jet Fleet – 1959 Through 2011



Scope of Aviation Operations

- While the National Airspace System is extremely safe, 70% of incidents that do occur are thought to result from human factors issues
  - Mechanical issues have experienced great declines
    - O'Hare, Wiggins, Batt, & Morrison (1994)
- Human Factors bridges the gap between the users and the systems (aircraft and air traffic control) to tailor interfaces such that errors are minimized

Specific examples

- In aviation, as in many fields, there is a trend toward increasingly tailored displays and controls with a user-centered design focus
- A vivid example is the “glass cockpit”, moving away from numerous data-centric analog dials and indicators to a user-centric, fluid display of information

Cockpit Changes

- DC3 cockpit

Cockpit Changes

- Airbus 380 cockpit

Navigation Displays

- Several non-intuitive displays (and any of dozens of paper maps) were needed for navigation

Navigation Displays

- Contemporary layout overlays information, provides dynamic, egocentric perspective

Images from Garmin.com

Flight Progress Strips

- Current operations utilize paper flight progress strips to coordinate certain operations
  - Some information handwritten
  - Physical transfer from position to position

Electronic Flight Progress Strips

- Information can be manipulated electronically (and/or handwritten)
- Transfer (and sharing) between positions electronically

Images from NavCanada.ca and Frequentis.com

Challenges with Flight Strips

- Paper flight progress strips have been designed to efficiently display information
- Modernization may not be simply "intuitive"
  - Expert workforce proficient in their use
  - Manual manipulation provides memory aids
    - e.g., "cocking a strip" in the strip bay
- Need to develop new technology that adds new functionality without eliminating tacit capabilities of the old system

Automation in Air Traffic Control

- Application of Levels of Automation research
  - e.g., Parasuraman, Sheridan, & Wickens (2000)
- Automation relieves the operator of some cognitive processing, along a continuum of contribution
- Examples
  - Automated handoffs – reduces landline communications by visually communicating a transfer of control
  - Conflict alerts – identifies a potential airspace conflict for the controller to resolve
  - Proposed decision support tools for scheduling that may suggest a rescheduled release time for a flight (and facilitate that coordination)

Automation Issues

- As in many fields, the challenge is to find the optimal level of automation
  - Relieve tedious, time consuming, or error-prone processing
  - Make task challenging enough for operators to maintain vigilance
    - i.e., operator must not be "lulled to sleep" passively monitoring an automated process

Closing Thoughts

- Human performance plays a much larger role in outcomes of aviation operations (i.e., safety) than any other factor
- By employing Human Factors standards and conducting Human Factors research, we can improve safety and efficiency
- "Intuitive" solutions are often the result of an extensive research and development endeavor

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